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INTRODUCTION: ACQUISITION OF WH-MOVEMENT

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1.1 Long Distance Extraction of Arguments and Adjuncts

We begin with a set of fundamental questions: At what stage do children allow long distance extraction of questions? Do they distinguish between adjuncts and arguments? Do they respect conditions on extraction from wh-islands? In our first set of studies we explored these questions with preschool children learning English; in other papers in this volume they are extended to children acquiring Carribean Spanish (Perez-Leroux), French and German (Weissenborn *et al*).

The heart of modern syntax has been the study of constraints on extraction. Long-distance extraction requires the presence of a functional category, the Complementizer Phrase, and the formation of chains of empty categories. An example is:

(1) Who did you say [cpt[_{IP}you saw [cpt[_{IP}Bill hit t]]]]?

Each of these features: the CP node, the nature of empty categories, the properties of the chain, and the kinds of lexical items (see, say) that permit them are subject to parametric variation, dialect variation, and what is called the "poverty of the stimulus". That is, the evidence received by the child is small, sometimes contradictory, and clearly insufficient to account for the grammar acquired unless a parametric system is assumed.

For these reasons it appears to be a most natural locus for acquisition research. Naturalistic data assembled by M. Takahashi showed that children as young as three exhibit LD-rules, but the naturalistic data does not allow us to ask a host of more refined questions about constraints and parameters. Therefore we developed a series of experiments to explore them.

A full understanding of the phenomenon requires that two other features be recognized: *wh*-words are treated as variables, and *wh*-words serve in other capacities: as echo-questions and relative clauses. These papers, in the first instance, focus on establishing the presence of each of these phenomena in English and in other languages. In addition, each of the papers pursues the theoretical implications of the data found.

The first question we asked therefore is: at what age do children exhibit constraints on acquisition. Our work began with the theoretical background provided by Chomsky (1986) but has moved to include work by Rizzi (1990), McDaniel (1989) and others. The primary assumption, shared by all, is that LD-movement is cyclical: a *wh*-word moves through a series of COMP nodes.

(2) When did the boy ask to call *t*?

The constrained nature of this chain is revealed by the fact that another *wh*-word will block extraction(marked by * on the trace):

(3) When did the boy ask how to call **t*?

This central fact, however, has a variety of interesting exceptions and special features. Primary among them is the fact that there is a distinction between arguments ("who", "what") and adjuncts ("why", "when", "where"). The arguments are required lexically by the verb whereas the adjuncts may appear freely with any verb.

In terms of reconstructing a chain, the argument cases permit the hearer to reconstruct the origin of the *wh*-word just by seeing where a verbally required object may be missing:

(4) Who did the boy ask how to help *t*?

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The verb "help" has two readings: one requires an object ("help someone") and the other is intransitive ("help" in general). Our experiments exploit this ambiguity to determine whether children, given a non-LD possibility, will allow LD readings where possible. In (4) the "who" can belong to "ask" or to "help".

The adjuncts must be linked by the chain represented through the intermediary trace. Therefore adjuncts are always blocked by intermediary wh-words:

- (5) When did the boy ask how to help *t?

We now turn to a more technical expression of these ideas, although the essence of what is going on can be understood without all of the technical ramifications.

Chomsky (1986), Rizzi (1990), and Lasnik and Saito (1984) each represent these facts in slightly different ways. Our work, in fact, bears upon the choice between them, but in this introduction we will limit ourselves to a discussion in Rizzi's terms. Rizzi argues that although both arguments and adjuncts require a chain through the medial COMP, only the adjuncts must have a c-commanding element. The presence of the other wh-word ("how") breaks the possibility of c-command for the trace of "when" in (5).

The question we first sought to explore had three facets:

- a) When do children allow long distance movement of wh questions?
- b) When do children show a constraint against extraction from wh-islands?
- c) When do children show evidence of a distinction in extraction for adjuncts and arguments?

In addition, we recognized that UG allows more possibilities than English manifests, so that children acquiring English may show evidence of grammars attested in other languages. We are still exploring the limits of UG, but there are at least three clear options across languages:

- a) No movement.

Asian languages in general have no wh-movement in the syntax. For instance, in Chinese the wh-word remains *in situ*:

- (6) Ni Xihuan shei?
You like who?

In situ wh questions appear in English as a "marked" option in echo questions, dependent on the preceding discourse:

- (7) I said I was going to Utah
You said you where going where?

In French colloquial speech, simple *in situ* questions are very common:

- (8) Il va où?

though wh-movement is also possible.

b) Short movement:

In some dialects of German, and in Romani, long distance movement of questions from a lower clause does not appear, but instead a chain is formed with the first wh-word serving as a scope marker over the whole sentence (McDaniel, 1989):

- (9) Was hat er gesagt wie er das Kuchen machen kann?
What did he say how he the cake make can?
(How did he say he can make the cake?)

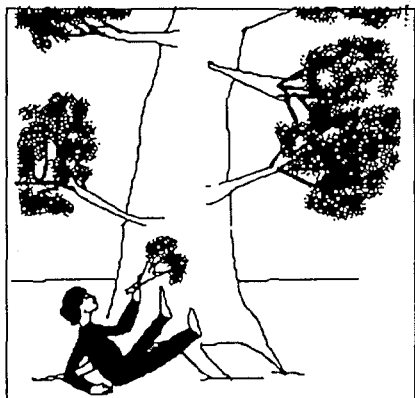
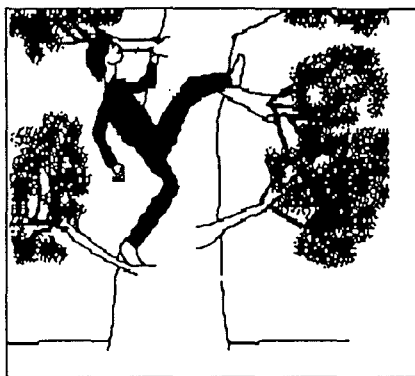
In this way wh-movement is clause-bound, and the medial wh-word takes on the role of a real question, unlike in English where it can not.

c) Long distance movement, with constraints.

In other languages such as English, French, Spanish, Greek and Italian, long distance movement of wh-questions occurs, with some variation in the bounds on that movement. So, for instance, it is claimed there is variation across languages as to whether S or S' or NP constitute bounding nodes for subjacency. In all these languages there appear to be wh-island constraints, and a distinction in movement possibilities for adjuncts versus arguments.

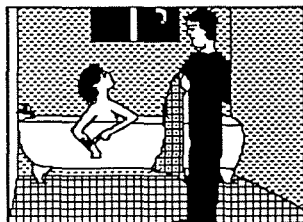
With these considerations in mind, it is clear that UG provides a number of options to the language learning child. A child encountering the language needs evidence of movement, and then evidence that will discriminate clause-bound from long distance movement. French children may be in some uncertainty over the former choice, but evidence to discriminate the latter

This boy loved to climb trees
in the forest.



One day he slipped and fell to the ground.
He picked himself up and went home.

That night when he had a bath,
he found a big bruise on his arm.
He said to his Dad, "I must
have hurt myself when I fell
this afternoon!"



two alternatives is also likely to be in rather short supply given the requirement of hearing two-clause questions involving unambiguous movement from the lower clause. Sentences such as the following would be possible triggers:

- (10) Who did he decide that he should call t?

in that there is only one possible gap for the wh-word. A search of the CHILDES database reveals few such sentences in the children's speech, and not many more in the parents', at least for the first several years. For this reason, we turned our attention to comprehension methodology to determine at what stage children can interpret questions as involving long distance movement.

In de Villiers, Roeper & Vainikka (1990) we presented a group of 25 children aged 3;7 to 6;8 with stories that contained all imaginable answers (including those ungrammatical for an adult) to a questions such as the following:

- (11) When did the boy say how he hurt himself?

An example story with pictures can be found in Figure 1.

Table 1 presents the variety of sentences used, together with the percentages of children giving either site of interpretation for each question. The children received two examples of each type, and four examples of the contrasting pair: ADJ-ARG and ARG-ADJ. Results showed significant differences in the movement possibilities of arguments versus adjuncts, as predicted by the current theories. The children respected the distinctions among sentence types, allowing long distance movement where adults find it possible (1,2,3 in the Table) and blocking it where adults also block it (4,5,6).¹ There was no difference in the extraction from infinitival or tensed clauses, and later work has confirmed that result with a more balanced design of stimuli. In the paper by Weissenborn et al (this

1. In fact, however, the explanation for the lack of LD movement in 5 is controversial, and may reflect a parsing bias rather than a grammatical restriction. Notice that choosing a matrix verb that does not allow an object, hence driving the interpretation to be long distance, only marginally improves it:

Who did she agree what to give?

The sentence seems to be fully acceptable in languages such as Spanish and Greek which have additional agreement markers to reinforce the connections to the lower verb.

volume), we discuss the significance of this for German in particular.

Table 1.

Preschool children's long distance interpretations of questions

(from de Villiers, Roeper and Vainikka, 1990)

Percentages refer to answers interpreting the wh-question with that site.

1	Argument	0 medial
Who did the boy	ask to call	?
	68%	32%
2	Adjunct	0 medial
When did the boy say	he hurt himself	?
	50%	44%
3	Argument	Adjunct medial
Who did the boy ask	how to help	?
	63%	30%
4	Adjunct	Argument medial
How did the girl ask	who to paint	?
	23%	8%
5	Argument	Argument medial
Who did the girl ask	what to feed	?
	70%	2%
6.	Adjunct	Adjunct medial
When did the clown say	how he caught the ball	?
	48%	6%

To understand the nature of the constraint more precisely, we presented a further group of children with questions in which the second question word was in final rather than in medial position:

(12) How did the girl decide to wear what?

In this sentence the second wh-word is *in situ*, and so does not occupy the medial spec of CP, leaving the adjunct free to move long distance. Notice also that the question becomes one involving what we will call a "bound variable reading", in which the two question words are both answered: "she decided to wear this in this manner and that in that manner". When the question

word is in medial position, the bound variable reading is not usual for English speakers:

(13) How did she decide what to wear?

can be answered e.g. "By looking in a magazine"². The children in the follow up study were 21 children in the same age range, and they showed a clear distinction between their interpretations for the medial and final wh sentences (see table 2). 36% of the time they answered as if the adjunct's trace were in the lower clause in (12), compared to only 5% for (13). Hence it is quite clear that it is the position of the wh-word in the lower spec of CP which results in a barrier to movement.

Table 2			
	Adjunct		Adjunct final
7. How did the girl decide _____ to wear _____ what?	25%		36%
8. How did the girl decide _____ what to wear _____ ?	72%		5%

2.1 Extraction from Clauses with no COMP.

In a second study (Roeper & de Villiers, in press a) we pursued the adjunct/argument distinction through a different set of constructions whose grammatical status has been disputed, namely small clauses. On some analyses, small clauses do not involve a COMP node at all, and their subject receives Case marking from the matrix verb:

(14) He saw her singing.

If the small clause is considered an extension of the matrix verb phrase, then it should be possible to allow long distance movement from within a small clause:

(15) How did he see her singing t?
Answer: "with her eyes shut".

Adults (see table 3) agree with this judgement. Notice, however, that the analysis only applies for those verbs

2. But not "over her left hip", because that would be long distance movement of the adjunct over a filled spec of CP.

which do allow "exceptional Case marking" - verbs like "see", "show", "hear" - and not other verbs whose complement structure resembles that of the small clause. Take the sentence:

(16) I enjoyed him running.

There is reason to distinguish "enjoy" from "see" on several grounds:

(17) * I enjoyed him run
I saw him run

and it appears that the verb "enjoy" is not the source of the Case marking of the embedded subject, i.e. is not an exceptional Case marking verb. What confuses the picture is the existence of a "default" Case marking such as is found initially in sentences:

(18) Me give him a ride? No way.

and postulated to account for the Case marking in ACC-ing constructions such as in (16). Supporting this argument is the fact of non-movement from such clauses with "enjoy":

(19) How did you enjoy him running *t?

to which the answer "With bare feet" does not seem possible.

To summarize the argument then, exceptional Case marking in small clauses seems to render the clause permeable to movement. However, other structures that do not involve exceptional Case marking are not permeable to movement, but the distinction in structures rests on a lexical distinction. A child might be expected to have difficulty discriminating which verbs permit extraction (and dictate the Case marking) and which verbs do not. If so, children might be conservative in allowing extraction from small clauses until they get the Case marking system fully established. This hypothesis accounted rather nicely for the results of the Roeper & de Villiers' study shown in Table 3.

Table 3		
Long distance interpretations in small clauses and nominalizations		
(data from Roeper & de Villiers, in press)		
Argument	Small clause	
9. Who did the sister show _____	him copying _____?	
Preschool (N=16)	25%	62%
Adult (N=12)	12%	83%
Argument	Nominalization	
10. Who did the sister show _____	his copying _____?	
Preschool	53%	25%
Adult	54%	37%
Adjunct	Small clause	
11. How did the mother see _____	him riding _____?	
Preschool	81%	18%
Adult	54%	45%
Adjunct	Nominalization	
12. How did the mother see _____	his riding _____?	
Preschool	88%	12%
Adult	91%	1%

This claim is made more precise by three other observations.

(a) children appear to have small clauses from the outset of the two-word stage (Radford, 1988) ("me big", "me sing").

(b), they do not have complementizers until much later; the use of "that" is late in the acquisition of English. Therefore it is surprising that children should allow extraction from tensed clauses with that years before they allow extraction from small clauses. To explain this, once again, we appeal to the fact that the subject of a small clause, in the adult grammar requires "exceptional" Case marking from a higher verb.

(c) Naturalistic studies provides direct support for the claim that children use a "default" Case marking rather than Case marking from the higher verb. Vainikka (1985) points out that both genitive ("my") and accusative ("me") are possible default case forms ("my do it").

The literature contains a number of examples like "help my dress" but never *"help my.

Thus clearly it is possible for a child to use Case marking that is not from the higher verb. Now we have good reason to regard cases like "help me dress" in child language as also not involving exceptional Case marking. Without Case marking from the higher verb, extraction should be impossible for the children. Our evidence suggests that it is.

As Table 3 shows, we contrasted the small clause construction with a closely similar construction, differentiated only by the Case of the pronoun: the nominalization:

(20) How did you see his riding?

Extraction from such a clause is a violation of the barrier constituted by a maximal projection, the NP. However once again the argument extracts more easily than the adjunct, for both adults and preschoolers (10 versus 12 in table 3)

To return to the small clause cases (9 and 11), the adults freely allowed long distance extraction for both arguments and adjuncts, but the children blocked adjunct extraction. The claim is that the adjunct would only be appropriately licensed if exceptional Case marking were in effect: it is for adults, it is not yet for the children.

3.1 Summary

We have now established several claims:

- a) Children by four years of age make the distinction between adjuncts and arguments in movement, suggesting that they have some version of the ECP by this age.
- b) Barriers to movement of the adjunct are introduced by the presence of a wh complementizer in the spec of COMP, and maximal projections such as NP nominalizations.
- c) The presence of a wh- word *in situ* in the lower clause does not create a barrier to movement from that clause.
- d) The small clause is not established as an environment for long distance movement until exceptional Case marking is acquired.

4.1 The Status of the Medial Wh-word.

Despite the delay for small clauses, the picture so far is one of surprisingly adult-like grammatical knowledge. Yet our introductory comments suggested that:

a) evidence is rare
 b) there is parametric variation across languages.
 If there were no parametric variation, then the lack of evidence would not be such a critical problem for language learning because certain assumptions could be built in. But the evidence for long distance movement is rare in children's input. Is there any evidence that they have made the wrong parametric choice in earlier grammars? In several places it has been suggested that wh-movement is absent in children's grammars at the start, and instead the wh-word is linked to a small pro rather than a trace (e.g. Roeper et al, 1984; de Villiers et al, 1990). Perez-Leroux (this volume) suggests for Spanish also that children begin with small pro at a younger age. The small pro analysis can account for cross-over violations (Roeper et al, 1984) beyond the age of four if small pro remains as a default which will recur under special demands. One special demand could be the generation of an LF structure with complex bound variables. A number of our experiments (see Roeper and de Villiers, this volume) have been directed toward discovering precisely how grammatically constrained knowledge of BV structures arises.

However, the presence of LD-interpretation with adjuncts ("How did he say to paint") and the barrier effects with a medial wh- ("How did he say what to paint") suggest, minimally, that children have a movement-trace analysis within a single clause. There is still another important question that remains open: do children have successive-cyclicity or can they form chains with two traces?

Our evidence suggests that children have another approach to LD-movement which may represent a stage where chains are blocked. However, the presence of the barrier effects found here suggests that by age four at least, movement- and-trace seems the better characterization of the grammar of wh-questions. There is still some question, however, about whether long distance movement is the only option that the children still have available. Recall that some languages permit short distance movement, with the initial question word serving as a scope marker. In such languages the medial question requires an answer. We have a huge amount of

data that suggest English-speaking children permit this option also³. Table 1 shows the percentages for answering the initial wh-word: in certain cases these percentages do not add to 100%: almost all of the remainder involve answers to the medial wh-word. Table 4 shows the incidence of this medial answer across question types in the study by de Villiers et al (1990).

Data from 3rd graders and adults from a study by de Villiers et al (in press) are shown also to demonstrate that the answers are vanishingly rare by age 9.

Also shown in Table 4 is the likelihood of a medial answer when the two question words are copies of each other: notice that the incidence of an answer to either clause is virtually identical to the case for a sentence with no medial wh at all. The possibility arises, then, that children's grammars also permit sentences in which a copy of the question word is left in the medial CP instead of a trace - a further possibility that other languages allow (McDaniel, 1989). We discuss these possibilities in more detail in Weissenborn et al (this volume). Perez-Leroux (this volume) gives a more complete analysis based on her Caribbean Spanish data.

Table 4				
Incidence of answering the medial question word.				
Structures:	Arg-Arg	Arg-Adj	Adj-Arg	Adj-Adj
<u>Subjects:</u>				
Preschoolers	28%	4%	68%	40%
3rd grade	7.5%	0%	5%	5%
Adults	0%	0%	0%	0%
How did the boy say _____ he hurt himself _____?				
	33.3%			37.7%
How did the boy say _____ how he hurt himself _____?				
	34.1%			38.6%

3. There is also naturalistic evidence e.g. "what did she say what it is" (Roeper, observation of his son) and extensive elicited production data from Thornton (1990) on behalf of this view.

5.1 Constraints on Extraction from Relative Clauses.

How much of the structure of the sentence does the child process when she answers the medial question word? We have assumed so far that the structure is treated as a grammatical option like that existing in German, but might there be a different explanation? It has been suggested to us on several occasions that young children may simply be answering the last clause, without parsing the matrix clause at all. The prediction is that children should be prone to answer all embedded wh-complements, which has not been reported. For instance, children should answer the question word in sentences such as:

(21) Do you know how to pour the milk?

or even:

(22) I asked her where he went.

We have not explored that issue directly, but we have asked children questions that include two wh-words, with the final clause masquerading as an extraposed subject relative such as:

(23) How did the boy drink who sneezed?

We had three questions about children's responses to these sentences:

a) Would the relative clause serve as a maximal projection NP) barrier to movement? In that case, the child should never answer the "how" with respect to "sneeze" in the above.

b) Would the child ever answer the medial wh-word, i.e. the relative pronoun, because they are parsing only the last clause?

c) Can children discriminate the main clause verb if there is an intervening relative clause? That is, the response that "respects barriers" is actually a long distance response in some cases.

The study involved 21 children aged 3 to 5, and the three types of relative clause structures shown in Table 5.

It is quite clear from the table that the children respected the relative clause barrier to movement. Virtually no answers assumed a site for the wh-question

inside the relative clause. Furthermore, even with embedded subject relatives, the matrix verb was correctly identified. Likewise, no child answered the medial wh-word as if it were the question, despite its being an argument wh-word. Thus the simplistic view that children are answering only the last clause must be discarded.

Table 5

Adjunct extraction from relative clauses

Subject relatives

13. How did the boy who sneezed _____ drink the milk _____?		
4 yr olds	0%	94%*
3 yr olds	0%	58%

Subject relative extraposed

14. When did the woman sleep _____ who painted the picture _____?		
4 yr olds	92%	2%
3 yr olds	47%	10.5%

Object relative

15. How did the woman help the man _____ who won the race _____?		
4 yr olds	91.5%	0%
3 yr olds	61%	0%

* The other responses were answers to some other question, unrelated to the one asked, e.g. to "where did they buy the milk?" No child answered the medial "who".

6.1 Other Barriers to Movement

We have substantial evidence, then, of the existence of barriers to long distance movement respected by children as young as 3.7 years⁴. Yet there are some puzzles remaining in this area. For example, in our very first pilot work (Roeper & de Villiers, in press), we attempted to test the distinction between "bridge" and "non-bridge" verbs in a similar comprehension task:

(24) How did the boy **say** t that he hurt himself t?

(25) How did the boy **know** t that he hurt himself t*?

4. In forthcoming work, we discuss a year-long longitudinal study of 15 children aged from 3 to 3.11 at the start of the study that confirms the existence of barriers even in the young three year olds.

The results showed a striking disrespect for the lexical distinction: exactly the same number of long distance responses were obtained for (25) as for (24), with children in the age group 3 to 6. The results are reminiscent of those in the small clause study, so that one could conclude that when a constraint rests on lexical distinctions, it is likely to be delayed in acquisition. The puzzle enters when the results are considered carefully: the children acted conservatively in the small clause case, assuming non-extractability: why did they behave without caution in this bridge verb case. The issue is ripe for further study.

In a second case we also find a lack of respect for constraints, and one that English-speaking children share with their French and German counterparts (see Weverink, this volume and Weissenborn *et al*, this volume). Weissenborn *et al* discuss the inversion facts in German and French as compared to English. They are led to a more complex theory of parametric variation in the system of V-2 structures.

We presented children with pairs of sentences in which aux inversion was contrasted in the lower clause:

(26) How did he say t Grandma can ride t?

(27) How did he say t can Grandma ride t*?

The only legitimate reading of (27) in most dialects of English is as a quotation, i.e. an adjunct to the verb not a complement. Extraction from an adjunct is impossible, hence the "how" must be interpreted with "say". Nevertheless, children freely interpreted (27) as equivalent to (26), allowing extraction from the quotation. The full results and an interpretation are to be found in Weverink (this volume). For now, it stands as a second example of a lack of adult constraints in children's grammar.

A different line of work published here by McDaniel & Maxfield concerns the child's understanding of sentences containing parasitic gaps:

(28) What_i did the lion smell t_i without eating t_i?

Their innovative experiments reveal a mastery of such wh-chains from a surprisingly early age.

7.1 Aux Inversion and Wh-Movement

Three papers in the volume (Plunkett, de Villiers, Roeper) discuss the nature of aux inversion in questions in English. Plunkett discusses the earliest evidence for aux inversion in the CHILDES data and argues that predication questions without a copula are compatible with a full wh and inversion analysis, suggesting that an initial "small clause" analysis may be incorrect. De Villiers explores the reasons for the long delay in aux inversion with "why" questions in English, and uncovers in the data from CHILDES and the experimental work a striking connection between the mastery of inversion in the matrix clause and the development of each question as a medial wh-complementizer. Roeper also discusses auxiliaries and inversion in light of do-insertion and copying rules. Examples from children like "John did left" may bear, at an abstract level, an important relation to wh-copying which we have just discussed.

8.1 Echo Questions

Since languages like Japanese and Chinese have no wh-movement in the syntax, the question immediately arises about how children know what kind of language they are in. The complications arise because Asian languages have topicalization of wh-words to the front of the sentence, e.g. the equivalent of:

(29) What you said?

whereas languages like French frequently permit questions *in situ*:

(30) Il va où?

and in English, echo questions are in great abundance in the young child's input:

(31) You said what?
You put it where?

With clever use of both naturalistic data and experimental innovation, both Maxfield (this volume) and Takahashi (this volume) explore the nature of echo questions and how English speaking children understand them. Once again, the facts reveal an early mastery of the distinction between echo and wh-questions both in the structures they permit and in the logical functions they serve.

9.1 Bound Variable Readings: Wh-Questions and Quantifiers.

The final papers in the volume explore in greater depth the logical characteristics of wh-questions, in particular, as bound variables. In a question such as:

(32) Who lifted his hat?

it is possible to get a bound variable reading, that is, to give an answer that pairs up answers to the quantifier "who" and the anaphoric pronoun "his": John lifted his hat, Bill lifted his hat, Sam lifted **his** hat and so on. If a pair of wh-words are involved, the bound variable answer is required:

(33) Who bought what?

In Roeper & de Villiers (this volume) we survey the studies we have conducted to find:

a) when bound variable answers emerge
and

b) when constraints on bound variable reading emerge.

This paper provides background to the more recent experimental work specifically on quantifier interpretation discussed in the papers by Philip & Takahashi (this volume) and Philip & Aurelio (this volume). In quantifier interpretation also, there are bound variable interpretations:

(34) Every boy sat on a chair

(ambiguous between the reading in which all the boys sat on one chair, versus each boy sat on his own)

and constraints (at Logical Form) on bound variable interpretation:

(35) There was a chair that every boy sat on

in which the reading of a chair for each boy is excluded. The explanation resides in the parallel movement at logical form of the quantifiers to the front of the sentence: movement is blocked from out of the relative clause in (35), such that "every" cannot move in front of "a" to take scope over it. The papers explore the degree to which children respect this invisible movement constraint, closing the circle of investigation we began with the first study.

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